**Inpatient Hyperglycemia - Adult**

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**PRESENTATION**

- Check hemoglobin A1c if not completed within the last 3 months
- Begin POC glucose monitoring

**INITIAL EVALUATION**

- Does patient meet diagnostic criteria for hyperglycemic emergency?
  - Yes
    - See Hyperglycemic Emergency Management (DKA/HHS/EDKA) – Adult algorithm
  - No
    - Type 1 diabetes or insulin pump or history of total pancreatectomy or history of DKA
      - Page Endocrinology-Diabetes for urgent consultation which requires clinician to clinician communication
    - Type 2 diabetes or steroid induced diabetes/hyperglycemia
      - See Page 2
    - No history of diabetes
      - See Page 4

**TREATMENT**

- Hemoglobin A1c may be inaccurate if recent blood transfusion within the past three months or severe anemia
- Diagnostic criteria:
  - DKA: blood glucose > 250 mg/dL and arterial pH < 7.3 or bicarbonate < 15 mEq/L, and moderate ketonuria or ketonemia
  - HHS: blood glucose > 600 mg/dL and arterial pH > 7.3 or bicarbonate > 15 mEq/L, and minimal ketonuria and ketonemia
  - EDKA: blood glucose ≤ 250 mg/dL, arterial pH < 7.3, serum bicarbonate < 15 mEq/L, and moderate ketonuria or ketonemia

[Note: Blood glucose may be lower than expected in patients on SGLT-2 inhibitors (e.g., canagliflozin, dapagliflozin, empagliflozin, ertugliflozin)]

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**Note:** Insulin dose adjustments should be made based on the individual patient's glucoses. Refer to the Hypoglycemia Management algorithm, as indicated.

### PRESENTATION

Type 2 diabetes or steroid induced diabetes/hyperglycemia

- Stop high-risk home medications
- Hold metformin if eGFR < 45 mL/minute/1.73 m²

### ASSESSMENT

- Does patient have risk factors for hyperglycemia or hypoglycemia?  
  - No  
  - Yes

- Is patient on > 100 units of insulin daily or on Humulin U-500 insulin at home?  
  - No  
  - Yes

- Are any glucose levels > 180 mg/dL after 48 hours?  
  - No  
  - Yes

### TREATMENT

- Consult Endocrinology-Diabetes
- Consult General Internal Medicine (Consultative Medicine - Inpatient Consults) or Endocrinology-Diabetes

**Consult General Internal Medicine**
- Consider resuming home medications, as appropriate
- Consider the following as clinically indicated:
  - For patients with hemoglobin A1c < 7.5%:
    - Follow up with treating physician, primary care physician, or endocrinologist
  - For patients with hemoglobin A1c 7.5-9%:
    - Consult Diabetes Educator
    - Follow up with treating physician, primary care physician, or endocrinologist or arrange ambulatory referral to Consultative Medicine (General Internal Medicine)
  - For patients with hemoglobin A1c > 9% or new to insulin on discharge:
    - Consult Diabetes Educator
    - Arrange ambulatory referral to Endocrinology-Diabetes

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eGFR = estimated glomerular filtration rate
NPH = neutral protamine Hagedorn
NPO = nothing by mouth
TDD = total daily dose
TPN = total parenteral nutrition

**Note:** Refer to Insulin Decision Support Tool to assist in placing orders (for internal use only)

1. Hold home insulin and oral hypoglycemic agents such as sulfonylureas (glipizide, glyburide, glimepiride, gliclazide), meglitinides (repaglinide, nateglinide) and SGLT-2 inhibitors (canagliflozin, dapagliflozin, empagliflozin, ertugliflozin). Generally, metformin and DPP-4 inhibitors (sitagliptin, linagliptin, saxagliptin) are safe to continue if renal and liver function are stable.

2. Calculation of total daily insulin taken at home: add the total units of all long acting (glargine, degludec, or detemir), intermediate acting (NPH), and short acting (lispro, aspart, glulisine, or regular) insulin in a typical 24 hour period

3. Risk factors for hyperglycemia include: new enteral feedings or TPN, post-operative status, high dose steroids (see Page 3)

4. Risk factors for hypoglycemia include: acute or chronic renal failure, poor nutritional status or oral intake, failure to thrive, NPO status for anticipated procedures

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Note: Insulin dose adjustments should be made based on the individual patient’s glucoses. Refer to the Hypoglycemia Management algorithm, as indicated.

Type 2 Diabetes or Steroid Induced Diabetes/Hyperglycemia

<table>
<thead>
<tr>
<th>RISK FACTOR</th>
<th>TREATMENT</th>
<th>EVALUATION</th>
<th>FOLLOW-UP</th>
</tr>
</thead>
<tbody>
<tr>
<td>New enteral feedings or TPN with glucose level &gt; 180 mg/dL</td>
<td>• Consider tube feeding formulas with lower carbohydrate count/higher fat content if appropriate for patient’s nutritional requirements&lt;br&gt;• Consider addition of regular insulin to parenteral nutrition (PN) based on dextrose content&lt;br&gt;• Consider Endocrinology-Diabetes consult</td>
<td>Are any glucose levels &gt; 180 mg/dL after 48 hours?</td>
<td>Consult Endocrinology-Diabetes</td>
</tr>
<tr>
<td>Post-operative status</td>
<td>• Initiate Post-Operative Insulin Basal Bolus order set (see Appendix B)&lt;br&gt;• Assess insulin needs every 24 hours&lt;br&gt;• If steroid use is anticipated on discharge, consider Endocrinology-Diabetes consult</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High risk for hypoglycemia: acute or chronic renal failure or failure to thrive</td>
<td>• Initiate basal insulin (glargine) at 0.15 units/kg/day subcutaneous and supplemental sliding scale bolus insulin (lispro) subcutaneous (see Appendix A and B)&lt;br&gt;• Assess insulin needs every 24 hours</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High risk for hypoglycemia: poor nutritional status or oral intake, or NPO status for anticipated procedures</td>
<td>• Initiate basal insulin (glargine) at 0.2 units/kg/day subcutaneous and supplemental sliding scale bolus insulin (lispro) subcutaneous (see Appendix A and B)&lt;br&gt;• Assess insulin needs every 24 hours</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High dose steroids1</td>
<td>• Initiate basal bolus insulin therapy at 0.6 units/kg/day subcutaneous with 60% of TDD used for prandial fixed bolus (lispro) dosing and 40% used for basal (glargine) dosing2 (see Appendix A and B)&lt;br&gt;• Assess insulin needs and steroid dosing every 24 hours&lt;br&gt;• If steroid use is anticipated on discharge, consider Endocrinology-Diabetes consult&lt;br&gt;• Consider a no concentrated carbohydrate diet</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Refer to Insulin Decision Support Tool to assist in placing orders (for internal use only)

1 High dose steroid therapy is considered to be ≥ 8 mg/day of dexamethasone, 50 mg/day of prednisone, 40 mg/day of methylprednisolone or 200 mg/day of hydrocortisone

2 If this is a recurrent admission for chemotherapy containing steroids, please check last Endocrinology-Diabetes note for more specific insulin dose recommendations and use if appropriate

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Note: Insulin dose adjustments should be made based on the individual patient’s glucoses. Refer to the Hypoglycemia Management algorithm, as indicated.

### PRESENTATION
- **No history of diabetes**
  - **Yes**
    - Is patient on high dose steroid therapy?  
      - **Yes**
        - Consult Diabetes Educator
        - Consult Endocrinology-Diabetes
      - **No**
        - Assess insulin needs and steroid dosing every 24 hours
        - Consider a no concentrated carbohydrate diet
  - **No**

- **Is patient on high dose steroid therapy?**
  - **Yes**
    - Consult Diabetes Educator
    - Consult Endocrinology-Diabetes
  - **No**

### ASSESSMENT
- **Are any glucose levels > 180 mg/dL after 48 hours?**
  - **Yes**
    - Consult Diabetes Educator
    - Consult Endocrinology-Diabetes
  - **No**

- **Is patient going home on steroid therapy?**
  - **Yes**
    - Consult Diabetes Educator
    - Consult Endocrinology-Diabetes
  - **No**

- **Are there 2 consecutive glucose levels > 180 mg/dL within 24 hours?**
  - **Yes**
    - Consider initiation of basal bolus insulin therapy at 0.3 units/kg/day subcutaneous with 50% of TDD used for prandial fixed bolus (lispro) dosing and 50% used for basal (glargine) dosing (see Appendix A and B)
    - Assess insulin needs every 24 hours
  - **No**

### TREATMENT

#### Discharge planning:
- **Consider the following as clinically indicated:**
  - For patients with hemoglobin A1c < 7.5%:
    - Follow up with treating physician, primary care physician, or endocrinologist
  - For patients with hemoglobin A1c 7.5-9%:
    - Consult Diabetes Educator
    - Follow up with treating physician, primary care physician, or endocrinologist or arrange ambulatory referral to Consultative Medicine (General Internal Medicine)
  - For patients with hemoglobin A1c > 9% or new to insulin on discharge:
    - Consult Diabetes Educator
    - Arrange ambulatory referral to Endocrinology-Diabetes

**Note:** Refer to Insulin Decision Support Tool to assist in placing orders (for internal use only)

1. High dose steroid therapy is considered to be ≥ 8 mg of dexamethasone, 50 mg of prednisone, 40 mg of methylprednisolone or 200 mg of hydrocortisone per day
2. Checkpoint inhibitors: nivolumab, pembrolizumab, durvalumab, atezolizumab, and related drugs. Patients with recent exposure to checkpoint inhibitors are at risk for DKA and should be evaluated for possible new onset type 1 diabetes mellitus.

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**APPENDIX A: Common Insulin Types and Frequency**

<table>
<thead>
<tr>
<th>Fast Acting Insulin</th>
<th>Dose Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lispro (Humalog(^1) or Lyumjev(^1))</td>
<td>Before meals or every 4 hours</td>
</tr>
<tr>
<td>Aspart (Novolog(^1) or Fiasp(^1))</td>
<td>Before meals or every 4 hours</td>
</tr>
<tr>
<td>Glulisine (Apidra(^1))</td>
<td>Before meals or every 4 hours</td>
</tr>
<tr>
<td>Regular insulin (Novolin(^\circledast)-R/Humulin(^\circledast)-R)</td>
<td>Before meals or every 6 hours</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Long Acting Insulin</th>
<th>Dose Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glargine (Lantus(^\circledast)/Basaglar(^\circledast)/Toujeo(^\circledast)/Semglee(^1))</td>
<td>Daily or every 12 hours</td>
</tr>
<tr>
<td>Detemir (Levemir(^\circledast))</td>
<td>Daily or every 12 hours</td>
</tr>
<tr>
<td>Degludec (Tresiba(^\circledast))(^1)</td>
<td>Daily</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Intermediate Acting Insulin</th>
<th>Dose Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPH (Novolin(^\circledast)-N/Humulin(^\circledast)-N)</td>
<td>Every 12 hours</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mixed Insulin</th>
<th>Dose Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>70/30, 75/25(^1), 50/50(^1) (mixes of NPH and a fast acting insulin)</td>
<td>Every 12 hours or every 6 hours with continuous tube feedings</td>
</tr>
</tbody>
</table>

\(^1\) Not currently on MD Anderson Formulary

**APPENDIX B: Basal Bolus Insulin Terms**

- **Bolus** insulin refers to a dose of fast acting insulin. This is typically comprised of **prandial** insulin which is scheduled to compensate for the carbohydrate content of a meal and **supplemental** (or sliding scale) insulin to correct hyperglycemia. Bolus insulin is most effective when given before meals, but supplemental insulin alone can be scheduled for patients who are not eating or are high risk for hypoglycemia.
- **Basal** insulin refers to a dose of long acting insulin given 1 or 2 times daily. These insulins absorb slowly to help maintain stable glucose levels.
- **Supplemental** insulin is dosed based on either weight or total daily insulin requirement.
- A **basal/bolus** insulin regimen uses both types of insulin to recreate a physiologic pattern of insulin release. This regimen is more effective for most patients than sliding scale supplemental insulin only. Most patients need about half of their insulin as basal and half as bolus. Patients on high doses of steroids will often need more bolus insulin.
SUGGESTED READINGS


Lansang, M. C., & Umpierrez, G. E. (2016). Inpatient hyperglycemia management: A practical review for primary medical and surgical teams. Cleveland Clinic Journal Of Medicine, 83(suppl 1), S34-S43. https://doi.org/10.3949/ccjm.83.s1.06


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